

AKAI TAPE RECORDER

MODEL M-7

SERVICE MANUAL

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I SPECIFICATIONS

MODEL NUMBER: Akai Model M-7, portable 4-track stereo tape recorder.

WEIGHT (NET IN CARTON): 47.3 lbs. (21.5 kg.) for M-7
2.4 lbs. (1.1 kg.) for all accessories supplied.

DIMENSIONS : 20"H×13"W×9"D, overall, case closed. (510H×340W×226D in m/m)

POWER REQUIREMENTS : A.C. 100, 110, 117, 200, 220, 230 or 245 volts interchangeable. 50-60 cycles.

POWER CONSUMPTION : 100 VA.

RECORDING SYSTEM: Specific "cross-field" recording based on the theory of trailless recording bias system. Inline 4 track stereo and 4-track monaural recording.

PLAYBACK SYSTEM : Inline 4-track stereo, monaural and 2-track stereo playback. Playback of monaural double-track and full-track recordings also possible.

TAPE SPEED : Three speeds; 7½" (19 cm.), 3¾" (9.5 cm.) and 1⅞" (4.75 cm.) per second.

TAPE SPEED DEVIATION : Less than ±3 per cent at all tape speeds.

WOW AND FLUTTER : Less than 0.15% R.M.S. at 7½ ips.
Less than 0.25% R.M.S. at 3¾ ips.
Less than 0.35% R.M.S. at 1⅞ ips.

FAST FORWARD AND REWIND TIME: 90 seconds for 1,200 ft. tape at 50 cycles and 75 seconds at 60 cycles.

FREQUENCY RESPONSE : 40 to 23,000 cps. at 7½ ips ±3 db;
40 to 20,000 cps. at 3¾ ips ±3 db;
40 to 10,000 cps. at 1⅞ ips ±4 db.

DISTORTION : Within 3 per cent T.H.D. at all speeds.

SIGNAL-TO-NOISE RATIO : 40 db below recorded level signal at all speeds.

CROSS TALK : Within 53 db between each track.

CHANNEL SEPARATION : Better than 60 db at 1,000 CPS 3 VU.

POWER INPUT LEVELS: Microphone input level

-55 db (VR. max) at 1,000 cps.
Phono and radio input level
-15 db (VR. max) at 1,000 cps.

POWER

OUTPUT : Head output, 1 mv. at 1,000 cps.
Pre-Amplifier output, 0.8 V at 1,000 cps, impedance 10,000 ohms
Main output, 34 dbm. up (in 600 ohms).

INSULATION

RESISTANCE : More than 10 MEG ohms

INSULATION

YIELD

STRENGTH: More than one minute at A.C. 1,000 V with Headphone

MONITORING

SYSTEM : (8 ohms) during recording.

MOTOR : Hysteresis synchronous, two-speed. motor. Capacitor start.
1/100 HP. Power ratio, 70 per cent.
3,000 to 1,500 rpm at 50 cps,
3,600 to 1,800 rpm at 60 cps.

HEADS : Inline four-track stereo/monaural record-play head;
Impedance...5,000 ohms at 1,000 cps.
Four-track, cross-field bias head;
Impedance...14,000 ohms at 60 kc.
Four-track erase head;
Impedance...18,000 ohms at 60 kc.

MICROPHONE

USED : Square-shaped, dynamic microphone.
Impedance...50,000 ohms
Sensitivity...55 db.
Frequency Response...70 to 15,000 cps ± 10 db.

SELF-CONTAINED

SPEAKER : 5×7" (12×18 cm.), oval-shaped, dynamic speaker;
Impedance...8 ohms
Allowable Input...6 watts
Frequency Response...80 to 12,000 cps, ± 10 db.

TUBES USED : 6267 (EF86) × 2, (12AD7) × 2,
6BQ5 × 2, 6X4 × 2, 6AR5 × 1.

REELS USED : Up to 7" reel

RECORDING

LEVEL

INDICATOR: Horizontal, A-model VU meter

II HOW TO MEASURE DESIGNATED VALUES IN SPECIFICATIONS

TAPE SPEED

DEVIATION : Record the 1,000 cps. sine curve of the tape speed at rating speeds with a standard sound recorder (AMPEX 351A, for instance) which is little affected by the tape speed deviation throughout the whole length of the tape. Put this standard tape on the tape recorder under test for playing back, and measure its output by a counter, then convert the value into rating power frequency to evaluate the tape speed deviation.

For a rough measurement, the tape speed deviation can also be measured with a speed test timing tape by the count on a stop watch.

WOW AND

FLUTTER : Playback the 3,000 cps. standard tape that guarantees wow and flutter within 0.07 per cent, and read the effective value on wow meter.

Since the sensibility of wow and flutter frequency below 2 cps and above 5 cps drops, the frequency over 5 cps is put to 3 db/OCT circuit, and the frequency below 2 cps is put to 6 db/OCT circuit for adjustment. This adjusted value is called auditory compensated value.

FREQUENCY

RESPONSE : Connect to the input terminal of the test recorder a sweep frequency of the level 20 db. Record the sweep signal, playback the tape, terminate the output with eight ohms.

Read the frequency response which should have a maximum deviation of 6 db.

TOTAL HARMONIC DISTORTION

FACTOR : Provide the input terminal of the tested recorder with 1,000 cps sine curve signals and record these signals on a recording tape at the zero level on the recorder's internal VU meter. Then playback the signals under the normal recording condition to measure the distortion factor by an oscillator. Remove the recording tape from the recorder, then read the noise level on the oscillator to get the required distortion factor by the following formula :

$$d0 = d - d1 - d2$$

d0...required

d...overall distortion factor

d1...noise level

d2...distortion factor of the oscillator used

SIGNAL TO

NOISE : Playback the sine curve, 250 cps tape recorded on a standard recorder on the tested recorder to measure the voltage.

Remove the tape, then measure the noise level under the same condition. Calculate the ratio between the two in decibel.

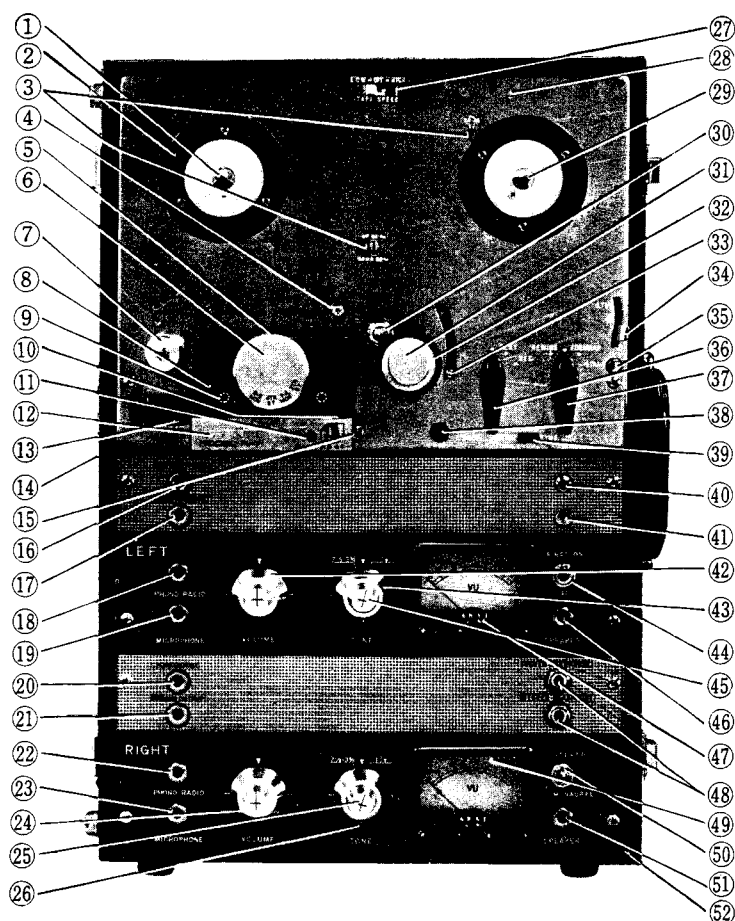
OUTPUT

: Playback on the test recorder the 1,000 cps. sine curve tape which was recorded at the zero VU level on a standard recorder. Terminate the test recorder with eight ohms. Square the voltage reading, then divide the figure by eight ohms to get the r.m.s. power output.

CROSS TALK

: Record 1,000 cps signal at + 3VU on the third track, then playback this signal thru a 1,000 cps. Band Pass Filter.
Compare the output of tracks 1 and 3 in decibels.

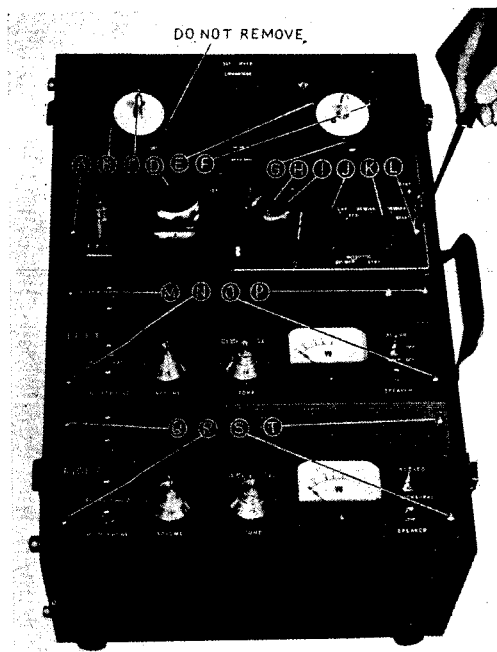
III LOCATION OF CONTROLS



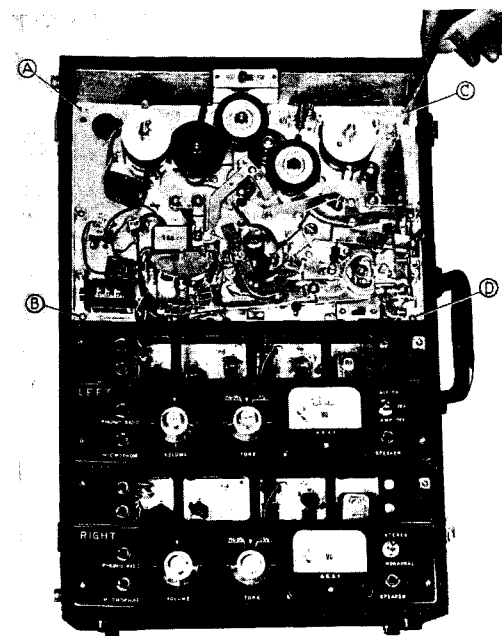
- | | |
|--|---------------------------------------|
| ① FEED REEL SPINDLE | ②⑦ SPEED CHANGE & ON/OFF SWITCH |
| ② GUARD CIRCLE | ②⑧ TOP (DECK) PANEL |
| ③ CYCLE CONVERSION SWITCH | ②⑨ TAKE-UP REEL SPINDLE |
| ④ CAPSTAN HOLDER | ③① CAPSTAN SHAFT |
| ⑤ RETAINING SCREW | ③② METAL CAP FOR PINCH ROLLER |
| ⑥ TRACK SELECTOR KNOB | ③③ PINCH ROLLER |
| ⑦ TAPE GUIDE ROLLER | ③④ AUTOMATIC SHUT-OFF LEVER |
| ⑧ HEAD COVER, MAIN | ③⑤ INSTANT STOP LEVER |
| ⑨ ERASE HEAD | ③⑥ START BUTTON |
| ⑩ RECORD/PLAY HEAD | ③⑦ RECORD, PLAY SWITCH |
| ⑪ CROSS-FIELD HEAD (RECORDING BIAS ONLY) | ③⑧ REWIND, FAST-FORWARD SWITCH |
| ⑫ HEAD COVER, SUB | ③⑨ RECORD SAFETY BUTTON |
| ⑬ INDEX (REVOLUTION) COUNTER | ③⑩ AUTO STOP SHUT-OFF SELECTOR SWITCH |
| ⑭ DIN (ONE CONNECTION) JACK | ④① PILOT LAMP (RECORDING INDICATOR) |
| ⑮ MOUNTING SCREW, SUB HEAD COVER | ④② INTERNAL SPEAKER ON/OFF SWITCH |
| ⑯ PICK UP INPUT (LEFT CHANNEL) | ④③ VOLUME CONTROL (LEFT) |
| ⑰ PRE-AMP OUTPUT (LEFT) | ④④ TONE CONTROL (LEFT) |
| ⑱ PHONO/RADIO INPUT (LEFT) | ④⑤ POWER SWITCH |
| ⑲ MICROPHONE INPUT (LEFT) | ④⑥ EQUALIZER SWITCH (LEFT) |
| ⑳ PICK UP INPUT (RIGHT CHANNEL) | ④⑦ SPEAKER OUTPUT JACK (LEFT) |
| ㉑ PRE-AMP OUTPUT (RIGHT) | ④⑧ VOLUME UNIT METER (LEFT) |
| ㉒ PHONO/RADIO INPUT (RIGHT) | ④⑨ STEREO HEADPHONE JACKS |
| ㉓ MICROPHONE INPUT (RIGHT) | ④⑩ VOLUME UNIT METER (RIGHT) |
| ㉔ VOLUME CONTROL (RIGHT) | ⑤① FUNCTION SWITCH |
| ㉕ EQUALIZER SWITCH (RIGHT) | ⑤② SPEAKER OUTPUT JACK (RIGHT) |
| ㉖ TONE CONTROL (RIGHT) | ⑤③ CARRYING CASE |

IV DISASSEMBLY TO REMOVE TAPE TRANSPORT UNIT & AMPLIFIERS

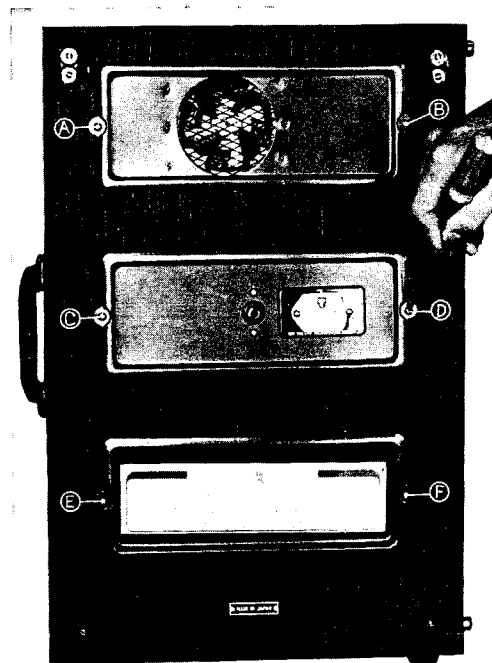
Remove *pinch roller cap* (H) by hand and loosen the 4 mm screw inside to pull *pinch roller* (I) out. Loosen screws holding *head wheel* (D) and *levers* (J) and (K) to pull them out. Loosen screws on (A) to (G) to remove these parts.



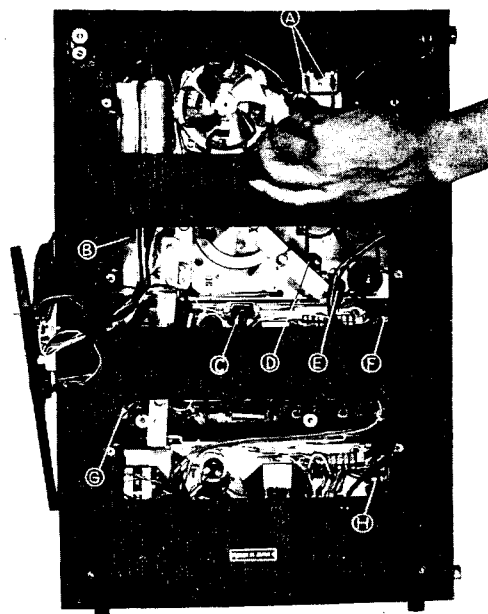
(2) Loosen 4 mm. screws on (A) to (D) to remove them.

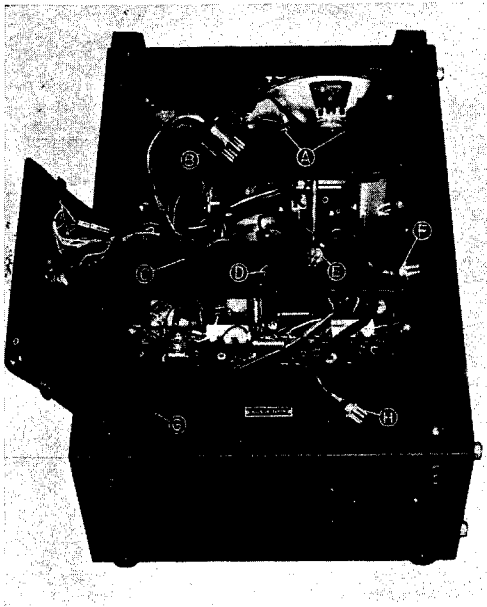


(3) Loosen 3 mm. screws on (A) to (F) to remove them.

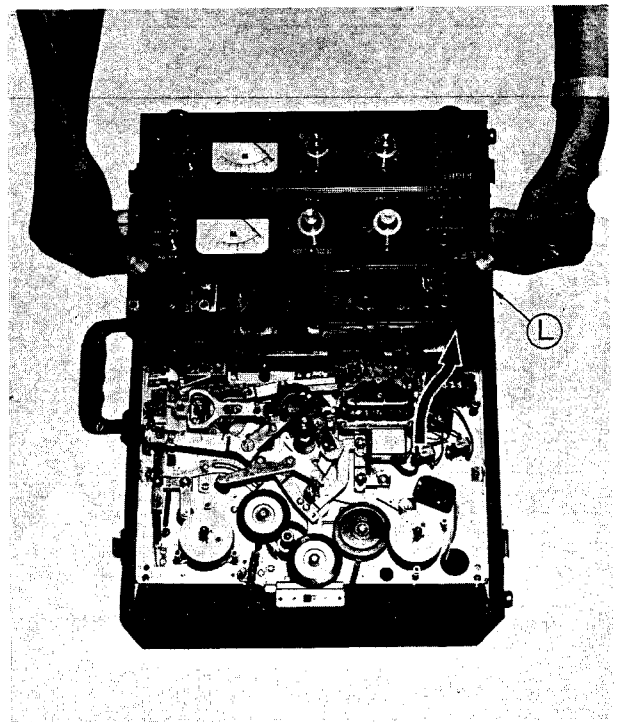


(4) Pull *plugs* (A) through (H) out by hand. (Picture ④ shows how the recorder looks after ⑤)

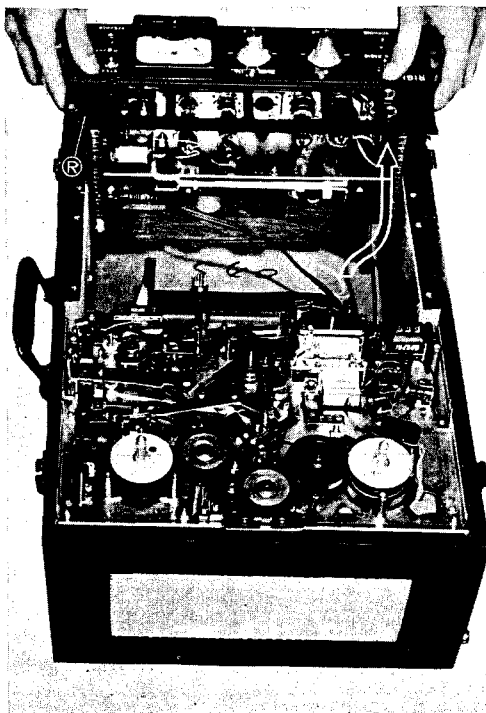




(5) Lift *left amplifier* (L) from case.



(6) Lift *right amplifier* (R) from case.



V TRANSPORT MECHANISM

Driving of Capstan

Figure 1.

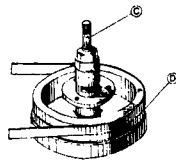
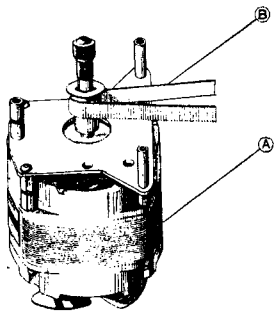


Fig 1

- (A) Motor
- (B) Driving Belt (flat belt)
- (C) Capstan
- (D) Flywheel

High-speed rotation of *Motor* (A) is reduced by *Driving Belt* (B) and transmitted to *Capstan* (C), which is connected to *Flywheel* with ample inertia and enables rating rotation by absorbing minor rotation distortion of motor itself. (See Fig. 1)

Capstan Rotation	606 rpm at $7\frac{1}{2}$ " (19m.) per sec.
	303 rpm at $3\frac{3}{4}$ " (9.5cm) per sec.
	151.5 rpm at $1\frac{7}{8}$ (4.75cm.) per sec.
Motor Rotation	3,000 to 1,500 rpm at 50 cps.
	3,000 to 1,800 at 60 cps.

Driving of Pinch Roller

Put tape between rotating capstan and pinch roller and push pinch roller against capstan, this will transport the tape at rated speed. The appropriate pressure of pinch roller at this time is between 1,000 to 1,150 grams at the tape speed of $7\frac{1}{2}$ (19 cm.) per second.

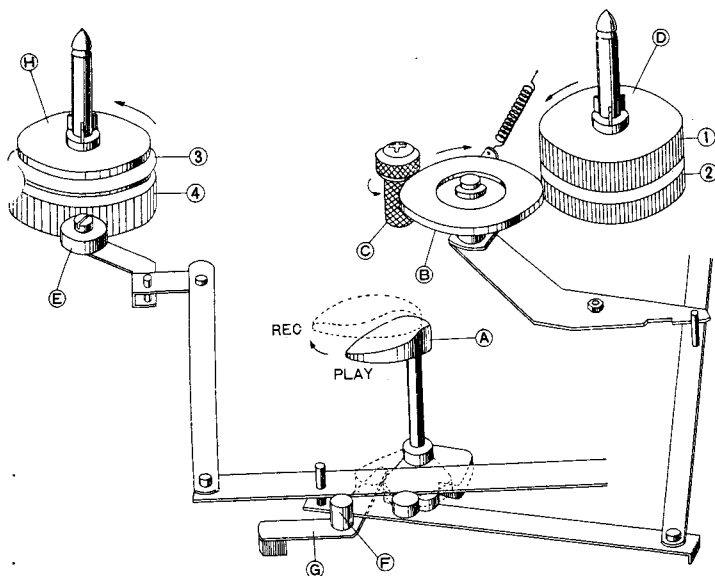


Fig 2

Recording and Play Back

Turn the *RECORD, PLAYBACK* knob (A) to "PLAY" position, and pinch roller presses hard against capstan to move tape at the rated speed. At the same time, *Idler* (B) moves between *Motor Bushing* (C) and the *Take-Up Reel Spindle* (D) to transmit the motor rotation to (D) so that the tape is moved and wound on the take-up reel.

The Take-Up Reel Spindle Base is made up of two plastic rollers (1 and 2) with a clutch felt in between. The Idler is rotating the plastic roller (2) below. Therefore, the tape-winding friction is adjusted by the slipping of the felt to enable rated winding of the tape.

On the other hand, the *Supply Reel Spindle* (H) has a *Brake* (E) hung on the Plastic Roller (4) below which provides appropriate back tension by the clutch felt slipping to the rotation of the Pulley (3) above.

To prevent accidental erasure, the *Record Interlock Button* (F) must be depressed before the *RECORD, PLAYBACK* knob can be moved to the "REC" position. The *Safety device* (G) is depressed to enter the record mode.

(See Figures 2 and 3)

Braked Rotation Slipping Rotation

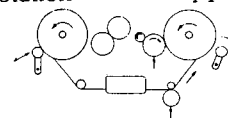


Fig. 3

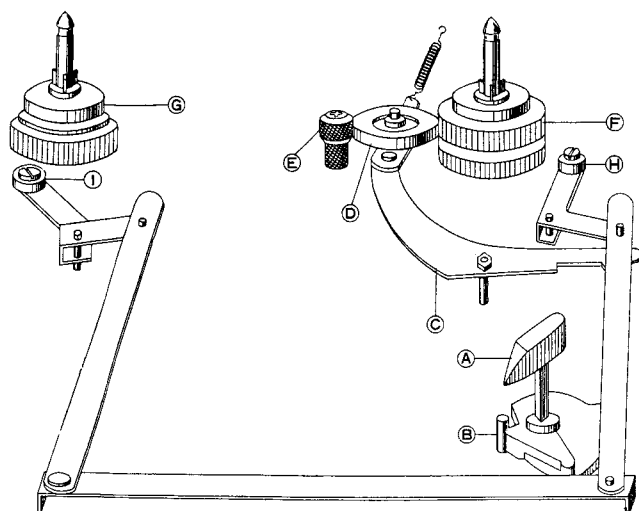


Fig. 4

FAST-FORWARD MECHANISM

Turn the **FAST FWD-REWIND knob (A)** to "FAST FWD" position, and the **cam (B)** under the knob pushes up the **Lever (C)**. The **Idler (D)** moves into the space between the **Plastic Roller (F)** above the **Take-Up Reel Spindle** and the upper part of the rotating motor drive bushing to transmit the motor rotation to the take-up reel spindle. At the same time, the **brakes (H)** and **(I)** come off the reel spindle to free the **Supply Reel Spindle (G)**, thereby allowing fast winding of the tape onto the take-up reel.

(See Figures 4 and 5)

Free Rotation High-Speed Rotation

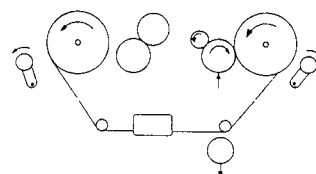


Fig. 5

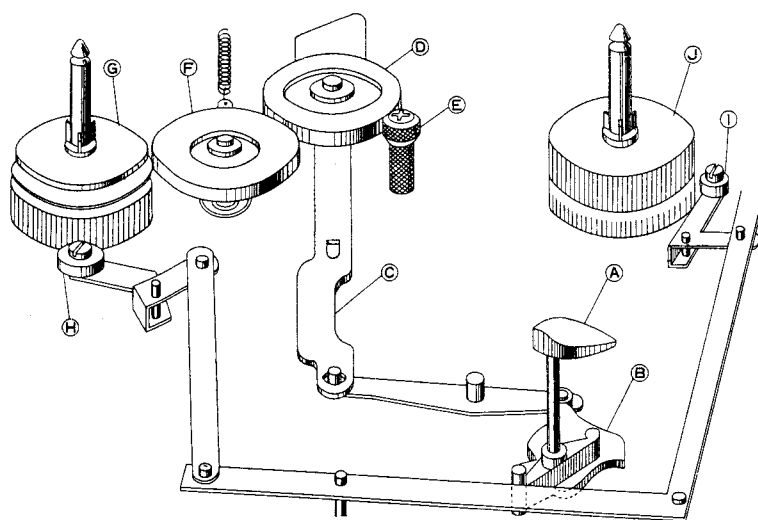


Fig. 6

REWIND MECHANISM

Turn the **FAST FWD-REWIND knob (A)** to "REWIND" position, and the **cam (B)** under the knob pushes the **Lever (C)** up. The **Idler (D)** moves into the space between the upper part of the rotating **Motor drive bushing (E)** and the **Intermediate Pulley (F)** to transmit the high-speed rotation of the motor through the intermediate pulley to the **Supply Reel Spindle (G)**. At the same time, **Brakes (H)** and **(I)** come off the reel spindle to free the **take-up reel spindle (J)**, thereby rewinding the tape into the supply reel at a fast speed.

(See Figures 6 and 7)

High-speed Rotation Free Rotation

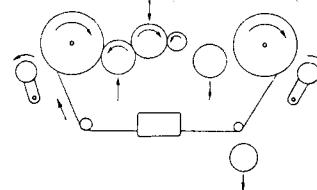


Fig. 7

Modes of Operation	Pinch Roller	Take-up Idler Wheel	Rewind Idler Wheel	Take-up-side Brake	Supply-side Brake
(a) STOP	×	×	×	○	○
(b) FAST-FORWARD	×	○	×	×	×
(c) REWIND	×	×	○	×	○
(d) RECORDING PLAYBACK	○	○	×	×	×

NOTES : ×-marks indicates "open" and
○-marks "engaged"

STOP CONTROL

Push the stop lever to "STOP" position, **brake rubber (A)**, and **(B)** depress reel spindles to stop rotation of the reel spindles.

As brake rubber depresses the plastic rollers under the reel spindles, no friction works on the tape itself.

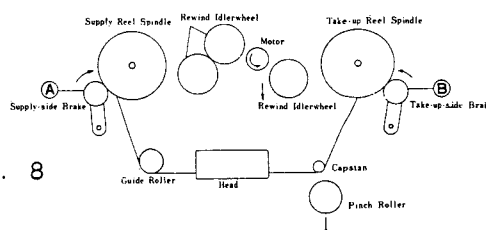


Fig. 8

AUTOMATIC STOP MECHANISM

When the tape is threaded on the pin (B) at the top of the Automatic Stop Lever (A) comes off the pin, the Automatic Stop lever returns to the original position by the action of springs. At this time, the panel spring (C) below the Automatic Stop lever slightly pushes down the projected part of the eccentric gear (D), which gears into the Flywheel Gear (E) to start rotating and pushing up the Momentary Stop Lever (G) that is connected with the eccentric gear base (F).

Thus, the eccentric gear maintains the mechanism in the state of tentative stop for "Playback" or "Recording".

For "Fast-forward," or "Rewind," the Corkscrew lever (H) works to push back the "FAST FWD, REWIND" knob to the "Stop" position before stopping itself.

When the Automatic Cut-Off Switch is moved to "CUT OFF" position, the Shut-Off lever (J) moves to the arrow-mark direction to cut the power circuit, thereby depressing the attached Micro Switch (K) to shut off the current.

(See a, b, c and d in Fig. 9)

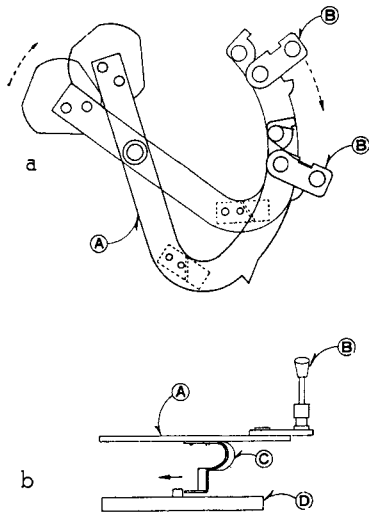
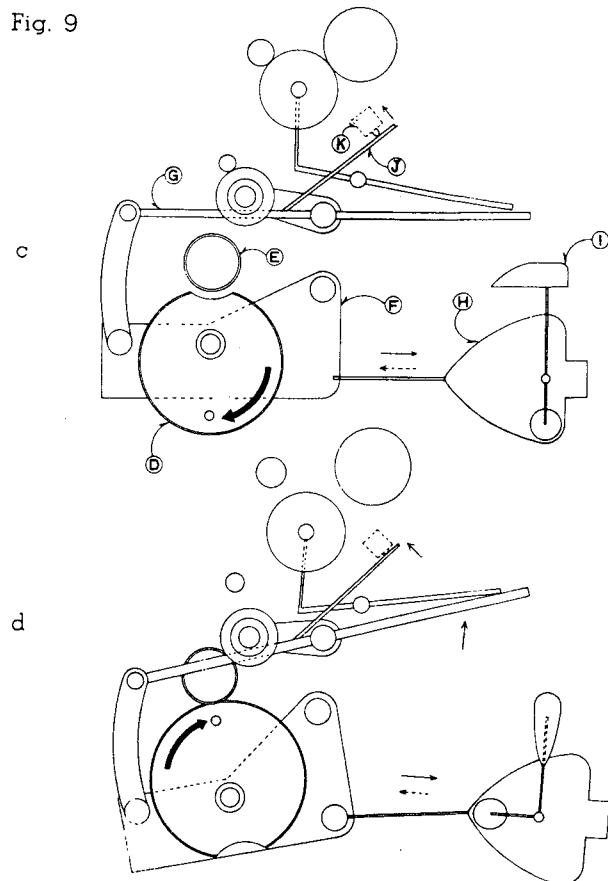


Fig. 9



VI ADJUSTMENT OF TAPE TRANSPORT UNIT

1. ADJUSTMENT OF PINCH WHEEL

It is important that the pinch wheel shaft be kept in complete alignment with the capstan shaft. A proper pinch wheel pressure is between 1,000 and 1,150 grams when the unit is operated at the tape speed of 7-1/2 ips. Any deviation from this specification will result in wow and flutter. Check pinch wheel pressure using a spring scale and, if necessary, adjust the pinch wheel load spring to suit.

2. ADJUSTMENT OF TAKE-UP IDLER WHEEL

The take-up idler wheel must be kept in complete alignment with the take-up reel shaft. When the unit is set in fast forward condition, the idler wheel will contact to the upper knurled wheel of the take-up reel shaft assembly, and it will contact to the lower knurled wheel during record or play mode. Adjust idler wheel load spring so that the idler wheel pressure is kept between 50 and 80 grams. The idler wheel wears rapidly if the pressure is excessive, and slippage occurs in case the pressure is smaller than the specification.

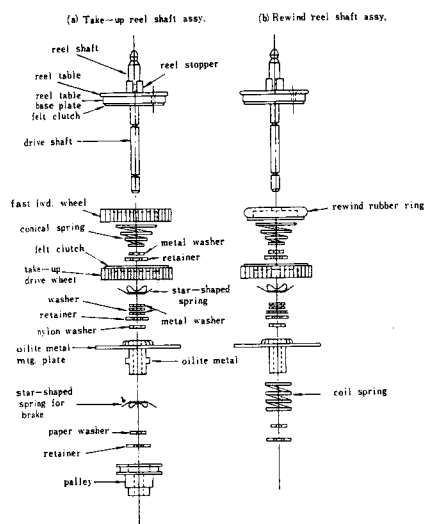


Fig. 10

3. ADJUSTMENT OF REWIND IDLER WHEEL

The rewind idler wheel must be kept in complete alignment with the rewind reel shaft. The amount of pressure to the knurled motor bushing should be maintained about 50 grams during rewind operation. Adjust both the idler load spring and rewind roller.

4. ADJUSTMENT OF INTERMEDIATE WHEEL

The intermediate wheel is located between the rewind idler wheel and the rubber ring which is used on the upper part of the supply reel shaft assembly. When the unit is set in rewind mode, it will contact to these parts simultaneously delivering torque of motor. An adequate pressure to be kept is 50 grams. Adjust the load spring of the intermediate wheel in case the pressure is not sufficient.

5. ADJUSTMENT OF TAKE-UP REEL SHAFT ASSEMBLY

A felt clutch material is attached to the bottom side of the reel table base plate so that recording tape will not be stretched during fast forwarding operation due to excessive tension. To check the amount of friction of this part, place onto the take-up reel table a 5-inch reel with recording tape wound by 60 m/m in diameter, and gently pull the end of tape upward using a spring scale. Adjust the conical spring so that the amount of tension at this part will be kept between 400 to 500 grams. Another felt clutch material is attached to the take-up drive wheel. It is used to provide proper slipping operation during record or play mode. The procedure for checking friction of this part is same as the foregoing, and between 120 and 200 grams of friction will provide the best result. Adjust the star-shaped spring immediate below the take-up drive wheel. When the unit is set in rewind mode, the amount of friction of this part will greatly be reduced and will become 10 to 20 grams. Check to see if this is satisfactory and, if not, readjust the star-shaped spring for Brake, and spring retainer washes accordingly. (See figure 10 (a) at left)

6. ADJUSTMENT OF SUPPLY REEL SHAFT ASSEMBLY

A felt clutch material is used between the lower side of the reel table base plate and the rewind rubber ring to protect recording tape from an excessive tension when rewinding operation. To check the amount of friction of this part, place onto the supply reel table a 5-inch reel with recording tape wound by 60 m/m in diameter and gently pull the end of tape upward using a spring scale. Adjust the conical spring so that the amount of tension be kept between 400 and 500 grams. Another felt clutch is attached to the rewind drive wheel and is used to provide proper slipping operation during record or play mode. The procedure for checking friction of this part is same as the foregoing, and between 80 and 120 grams of friction will give the best result. When the unit is set in fast forward mode, the amount of friction will greatly be reduced and will become 10 to 20 grams.

Check to see if this is proper and, if not, readjust coil spring and spring retainer washer to suit.

7. ADJUSTMENT OF TAPE HEAD

(See figure 10 (b) at left)

A vertical azimuth alignment of tape head is the only adjustment that can be made at the field of service. To align tape head, play 8,000 cycles recorded on an Ampex standard alignment tape. Rotate the azimuth alignment screw until a maximum playback level through the small hole which is positioned on the shield cover of the tape head assembly.

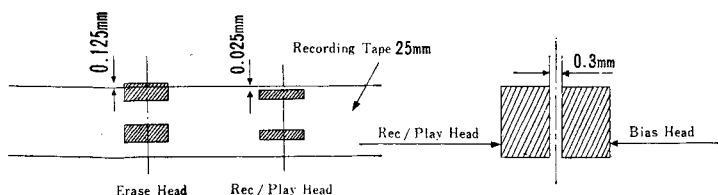


Fig. 11

VII ADJUSTMENT OF AMPLIFIER

1. ADJUSTMENT OF RECORDING BIAS FREQUENCY

Recording/erasing bias frequency has been set at 60 KC plus or minus 5 KC before shipment. It is decided by inductance of the oscillator coil (part # OSC 60) and its resonant capacitor (part # C-22). To measure recording bias frequency, insert a 10 or 100 ohm resistor in series to the record/play head and connect vertical input terminals of an oscilloscope as shown in the Fig. 12. Another testing instrument to be prepared is an audio frequency oscillator and its output should be connected to horizontal input terminals of the oscilloscope. Vary frequency being generated by the audio frequency oscillator around 60 KC, and set the oscillator at the point where a lissajous figure appears on the oscilloscope. The recording bias frequency now corresponds to the reading of the oscillator. Check oscillator coil, C-22, C-27 and bias head if recording bias frequency measured is not within 60 KC plus or minus 5 KC.

Fig. 12

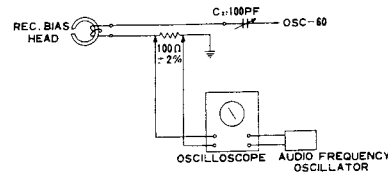


Fig. 13

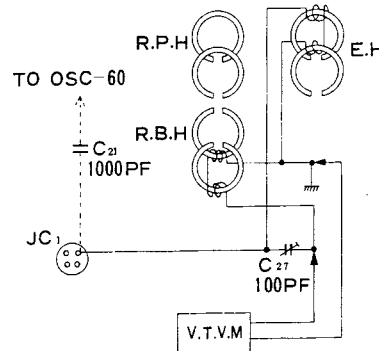


Fig. 14

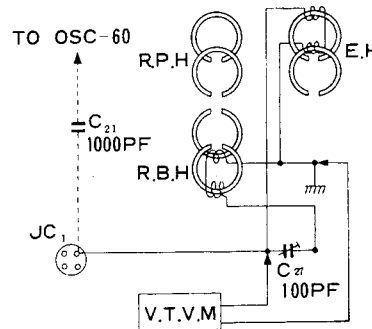
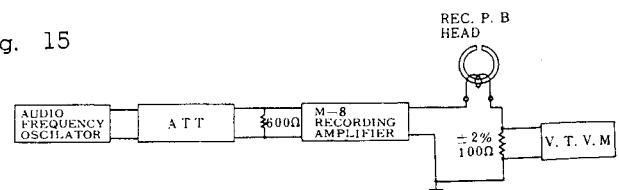


Fig. 15



$$\text{Current (mA)} = \frac{\text{Voltage (V.T.V.M.)} \times 10^3}{100 \Omega}$$

VIII MAINTENANCE PROCEDURES

1. LUBRICATION INSTRUCTION

For maximum service life and optimum performance, lubricate the parts identified below after each 500 hours of operation. Use only light machine oil of good quality

Motor	3 drops
Drive Capstan Shaft	2 drops
Rewind Idler Wheel Bearing and Wind take-up Idler Bearing.	1 drop
Intermediate Idler Bearing	"
Pinch Wheel Bearing	2 drops
Take-up and Supply Reel Shaft Bearing &	"

Also apply a liberal film of light machine grease to each roller surface of all levers and cams.

CAUTION: DO NOT OVER-LUBRICATE, AND WIPE OFF EXCESS IMMEDIATELY USING A COTTON SWAB SOAKED IN ALCOHOL. OTHERWISE, THE OVER-FLOWED LUBRICANT MAY BE SCATTERED DURING OPERATION AND DETERIORATION OF RUBBER COMPONENT PARTS WILL RESULT.

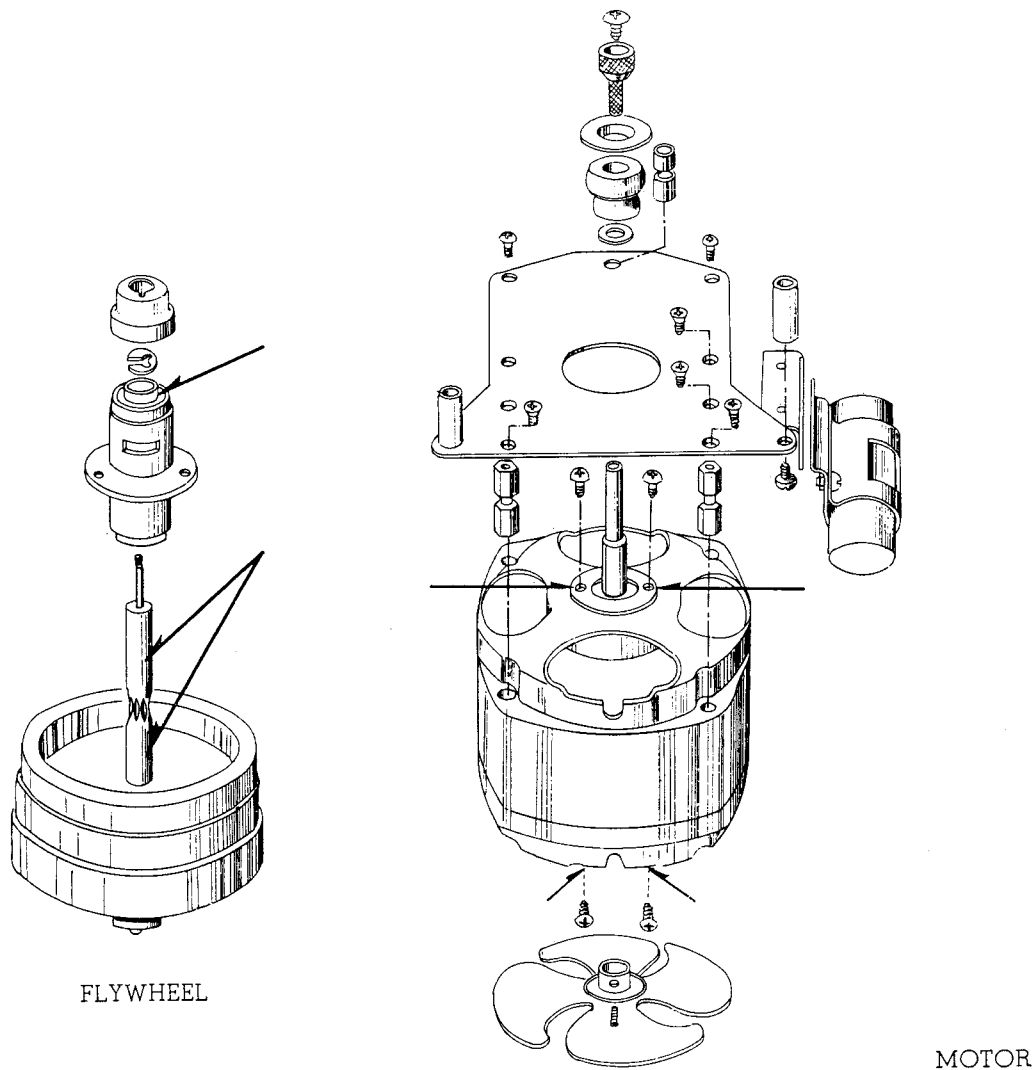


Fig. 16

MOTOR

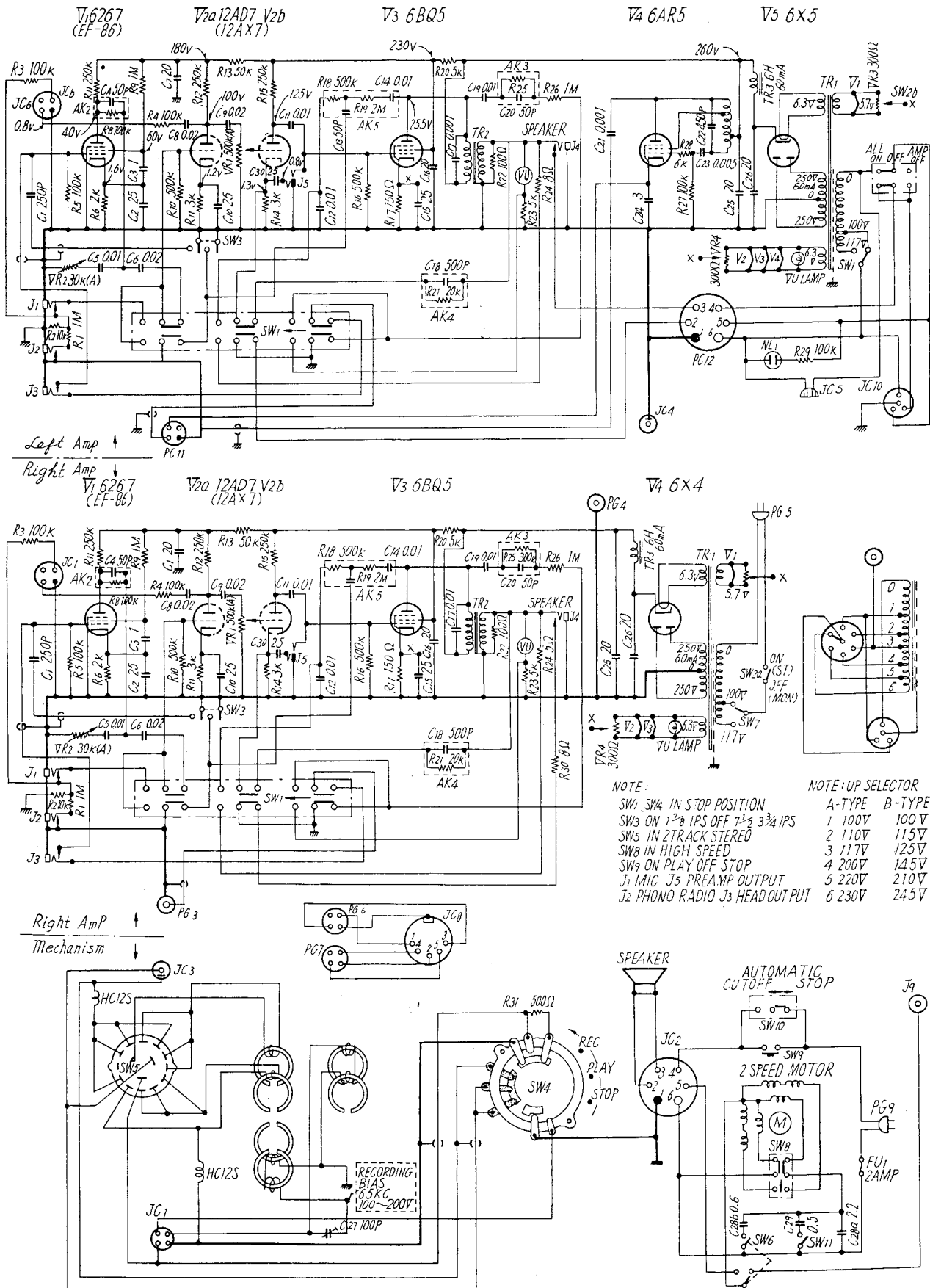
2. CLEANING TAPE HEADS AND OTHER PARTS

Wipe surface of tape heads, guide roller bearing, capstan bushing and pinch wheel periodically with a soft cloth soaked in alcohol or carbon-tet.

IX SCHEMATIC DIAGRAM

LATEST

M-7 SCHEMATIC



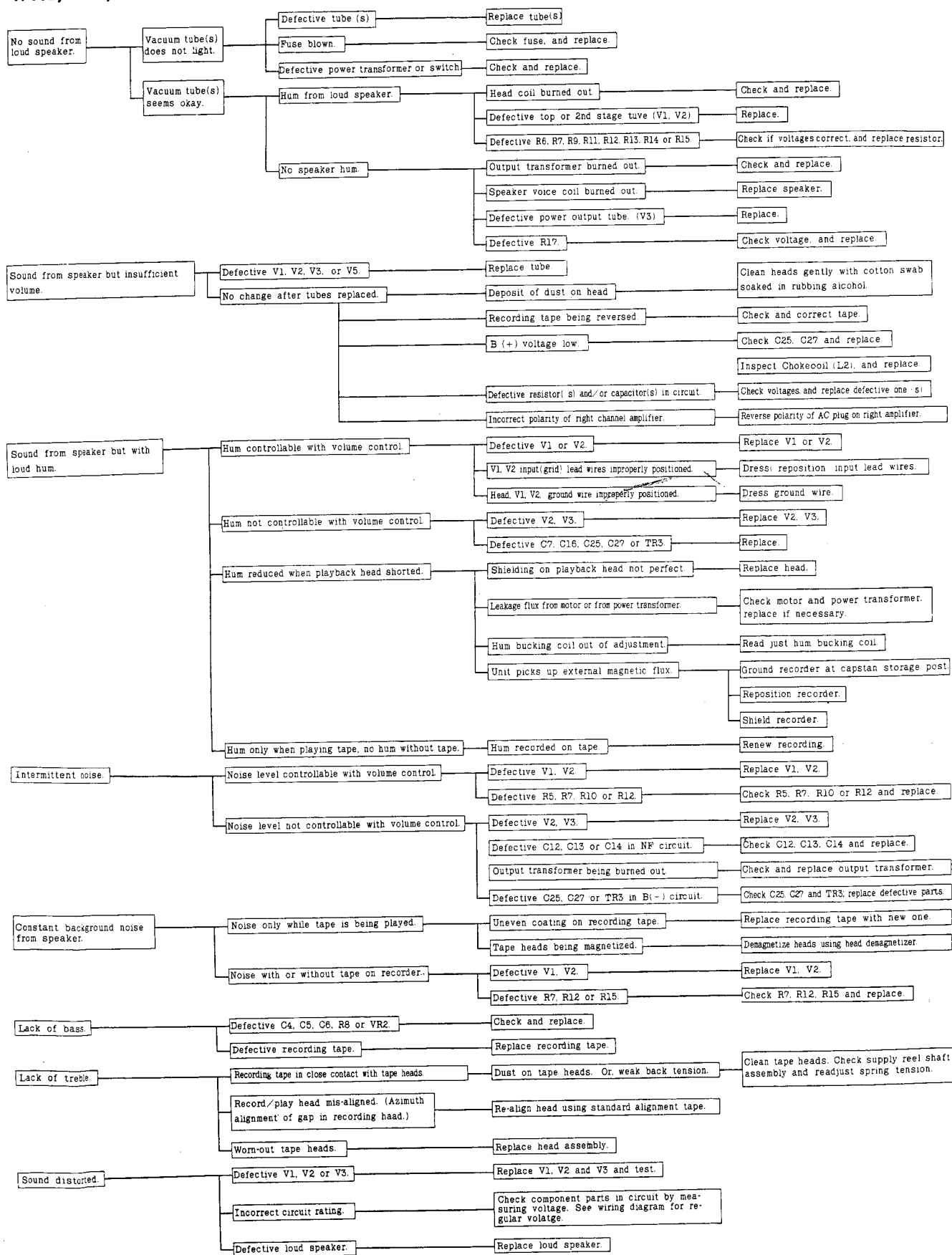
NO 630215

AKAI ELECTRIC CO., LTD.

X TROUBLE SHOOTING CHART FOR MODEL M-7

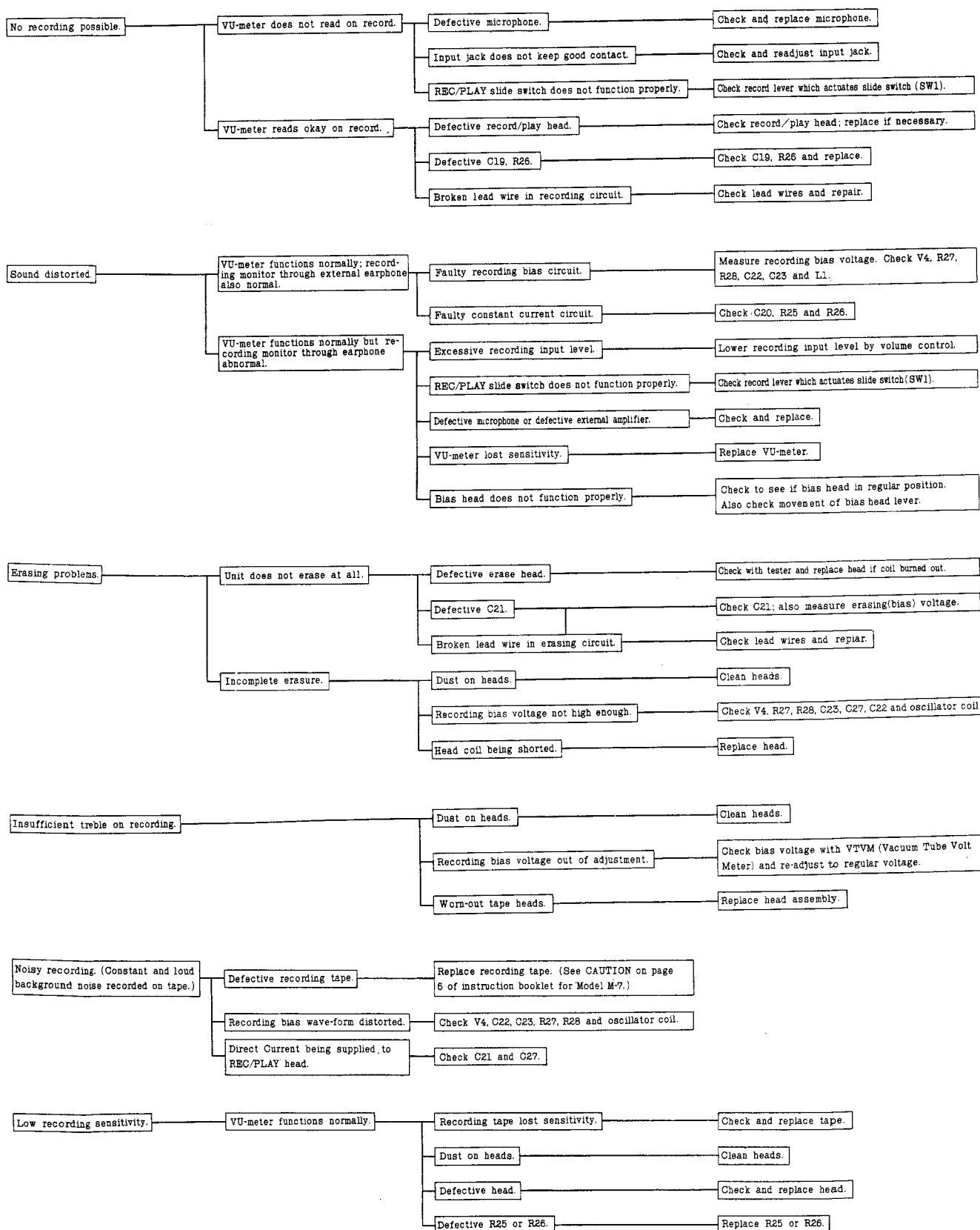
SECTION "A" TROUBLES WITH AMPLIFIER

1. Playback problems. (Unit set in play position.)



2. Recording Problems.

(Unit plays back pre-recorded tapes okay, but recording not satisfactory.)



SECTION "B" TROUBLES WITH TAPE TRANSPORT MECHANISM.



SECTION "B" TROUBLES WITH TAPE TRANSPORT MECHANISM.



XI MODEL M-7 CONNECTING DIAGRAM

